

# Three Phase Sanitation Program in the Klamath Flood Disaster

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OF the many activities carried on by the sanitation staff of a health jurisdiction, none can so strain the personnel, facilities, and general program as that required by a major disaster. Beginning in December 1955, the Humboldt-Del Norte County Health Department dealt with the special sanitation problems left by the flood of the lower Klamath River in Del Norte County, Calif. The sanitation program following the disaster operated in three phases: emergency, removal of flood debris, and rehabilitation. The objectives were to prevent the outbreak of any major epidemic, to protect the public health and safety, and to return the affected areas to normal as soon as possible.

The flood disaster occurred at the mouth of the Klamath River where the communities of Klamath, Terwer Valley, and Klamath Glen are located on the extreme flood plain. There the runoff of a watershed comprising more than 15,500 square miles empties into the Pacific Ocean.

The lower Klamath River was subject to the greatest flooding in the history of its recorded stream flow during the week preceding Christmas of 1955. The previous record peak flow at Klamath was 297,000 second-feet with a gauge height reading of 43.7 feet in January 1953. On December 22, 1955, the peak flow at Klamath was 400,000 second-feet with a gauge height of 49.7 feet (1). From December 19 to 25, the total volume of flow past the town of Klamath was 2,500,000 acre-feet.

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The Del Norte County Civil Defense Office later reported that 700 families, or about 2,450 persons, had to abandon their homes for the first 24 hours following the flood peak (2). In the town of Klamath, 312 structures were destroyed or damaged; 212 were individual homes. In the Klamath Glen and Terwer Valley areas, more than 47 residences were lost or damaged. The flood caused an estimated damage of more than \$3,500,000 to an area along the lower Klamath River covering approximately 8 square miles.

As the flood waters receded, the full extent of damage to sanitation and the corresponding threat to public health and safety began to emerge. The contaminated and silt-laden flood waters had swept foodstuffs, furniture, clothing, and parts of buildings into mountains of debris, clogging the streets and commercial establishments. Buildings were knocked off their foundations; some were ripped up and deposited on the roads. Collected in gaping holes, themselves a threat to public safety, were sewage effluent, organic wastes, and other debris. The community water systems in the area were crippled. Sewage disposal was brought to a virtual standstill. Natural drainage courses for the runoff of normal surface water were altered by heavy deposits of silt.

## The Emergency

During the acute emergency, the sanitation staff of the bi-county health department worked under the direction of the civil defense medical officer for Del Norte County. When communications were again functioning between the disaster area and headquarters of the health de-

partment, the department undertook joint jurisdiction with the civil defense medical officer of emergency sanitation.

The first job was to check and supervise mass feeding centers, water supply points, food distribution centers, and general emergency sanitary facilities. City water and a sewer system were available to the mass care center in Crescent City. The other centers, which were close to Klamath and the flooded area, had to depend on individual wells and septic tanks for water and for sewage disposal. We maintained constant surveillance of the water used at these centers by frequent checks and sampling. Despite overcrowded and strained facilities, however, sanitation was maintained at a high level in the mass care centers, and no major epidemic occurred.

After the flood waters receded, the town of Klamath, which had suffered the worst flooding, was placed under quarantine in an attempt to prevent looting and distribution of contaminated foodstuffs. The three lower Klamath River communities were surveyed to ascertain the extent of damage and the needs of the devastated area.

The most obvious need was for removal of the huge piles and pockets of debris. It was equally obvious that emergency organization and outside aid would be required simply to remove the superficial debris from the area.

The postflood survey drew attention to the special problem presented by the gaping holes which pitted the ground in Klamath, Terwer Valley, and Klamath Glen. Some of these holes predated the flood, but many had been made by it. They ranged from 2 to 20 feet in depth and from 10 to 200 feet in length. Because of their depth, location, or contents, we recommended that they be filled.

The only means of sewage disposal in the lower Klamath River area is by individual septic tank or cesspool. Before the flood, existing facilities were known to be seriously substandard. A survey of the town of Klamath in June 1954 showed that of more than 121 systems found, only 13 percent were up to California public health standards (3); 38 percent were barely passable; and 49 percent were below standard and constituted a hazard to the

public health. Other parts of the lower Klamath River area presented the same conditions to a lesser degree.

As a result of the flood, nearly all the individual sewage disposal systems in the town of Klamath and its immediate surroundings were ruptured, silted-in, or otherwise made inoperative. The Terwer Valley area suffered some sewage disposal trouble, and the systems in Klamath Glen were completely destroyed.

Chemical toilets were stationed throughout the affected areas for use until the septic tanks could be cleaned out and restored. By contract terms arranged through civil defense authorities, a private sanitation company supplied and maintained the toilets under health department supervision. Experience in this and an earlier flood (January 1953) has convinced the health department that chemical toilets, maintained by a private concern and supervised by department sanitation staff, are the best means of emergency sewage disposal in a disaster. We found construction of sanitary privies impracticable because of the maintenance required.

Provision of safe and potable water during the emergency was not a big problem. Fortunately, a number of watering points—wells and springs—in and near the disaster area were untouched by the flood waters. People were cautioned to boil or otherwise disinfect all water, and a program of testing and decontaminating individual wells was begun. We investigated and sampled all watering points which could be drawn upon as sources of public supply. At first people brought their own containers to the approved sources. Later on water was distributed by the local fire district's pump truck. Plans were made to send drinking water around to workers in the cleanup program via the Red Cross canteen truck and the Salvation Army mobile mess unit. There was enough safe, potable water to fill all individual and domestic needs without rationing.

#### **Removal of Flood Debris**

By authorizing the bi-county health department to supervise a program of flood debris removal and rehabilitation, the board of supervisors of Del Norte County officially recognized the county's responsibility for these postflood



**Flood peak in Klamath on December 22, 1955.**

*Courtesy Del Norte Tripletate*

activities. Funds for the program were made available to the county through Federal grants under Public Law 875 (81st Cong.), as a disaster relief measure. The sum of \$103,600 of Federal funds was budgeted for the removal of flood debris, destruction of unsafe buildings, emergency garbage disposal, and other contingencies affecting public health and safety. Additional amounts of \$75,576 for the filling of the holes and \$1,000 for the cleaning of septic tanks were granted under Public Law 875.

Flood debris removal began on December 27, 1955, with the signing up and hiring of the cleanup and heavy equipment crews which were already at work in the area. All labor and equipment used for 3 days after the flood had been donated to the program.

Three working crews, each with a foreman, were organized to do general cleanup work, op-

erate heavy equipment, and provide emergency garbage and rubbish collection. Two crews, one operating heavy equipment and one collecting garbage and rubbish, worked in and around the town of Klamath. A third crew performed all three functions in the Terwer Valley and Klamath Glen areas.

One great asset to the cleanup program was the availability of heavy equipment and operators from the local lumber mills and logging operations in the Klamath region. More than 20 pieces of equipment were used daily in the first 2 weeks; a smaller number sufficed for the remainder of the program. This equipment consisted of dump trucks, tractors and carryalls, a pickup crane, loaders, tow trucks, pickup trucks, and logging trucks. The machines were used to move buildings off the roads, remove debris, collect garbage, and salvage property.

Payment was on a force-account basis with the equipment and its operation rented at established rates per hour.

In the town of Klamath, flood debris removal was first concentrated in the commercial section. Cleanup crews were at once put to work removing debris, rubbish, and flood-damaged foodstuffs from the restaurants, grocery stores, and taverns. Immediate attention to the food and drinking establishments was necessary to forestall a serious garbage problem, the illegal distribution of flood-damaged foodstuffs, and to prevent an infestation of rodents and insects.

Nonfood commercial establishments were then cleared of contaminated debris. We ordered that every business establishment where the public could encounter risk be cleaned. At the same time, the emergency garbage and rubbish collection crew was hauling garbage and flood debris to the public dump. Except in a few cases, private residences were cleaned by their owners. All possible speed was urged in this program, for we felt that only with rapid removal of the debris could an area where sanitation was so poor escape the outbreak of an epidemic.

The cleanup program included the destruction of flood-damaged buildings in and near the town of Klamath. Of the 68 parcels of occupied land in Klamath, structures on 18 had been wiped out by the flood. Under the cleanup program, damaged structures on 9 parcels were removed with the owner's written consent, and 1 or 2 damaged housing units were removed from 3 parcels of land on which other housing units remained intact.

In the second stage of the program the working crews were employed in a wooded area adjacent to and down river from the town of Klamath where flood debris of all kinds had drifted and lodged. To forestall a serious infestation of rodents and insects and to prevent use of damaged building material for possible substandard housing, the area was cleared and burned.

The cleanup effort began in the Terwer Valley and Klamath Glen areas after some delay due partly to a shortage of manpower and partly to the absence of many individual property owners who had been driven from their homes by the flood. However, no rubbish or flood

debris was removed from individual property until the owner was able to salvage what he could. Dead animals, a serious problem in this area, were buried in one of the flood-made holes.

The health department also supervised the cleaning of those septic tanks and cesspools which had been so affected by the flood as to endanger public health. This project cost about \$900 more than the \$1,000 budgeted for it, but more than 234 loads were pumped from 54 individual systems by a special contract made with a local septic tank cleaning firm. Under this contract the local firm was paid \$7.50 per load pumped, and the county paid for the gas and oil used. The usual cost per load of septic tank pumping is \$17.50 for the Klamath area.

### **Rehabilitation**

Rehabilitation following the disaster included the filling of holes; the correction of the acute drainage problem caused by the flood; restoration of the community water system in Terwer Valley and the attempt to rehabilitate the water system in Klamath; the supervision of the rebuilding of sanitary facilities; and the emergency housing program.

Filling the holes became the most controversial project of the entire postflood program. After the county board of supervisors ordered that the holes designated by the health department be filled, the California State Office of Civil Defense was to award the work contract to the State Division of Highways. However, the board of supervisors was informed that this job would be a county responsibility. In order to expedite the request for funds under Public Law 875 and prepare the necessary paperwork for the task, a cursory survey was made of the holes in the town of Klamath only, and estimates were obtained as to the amount of fill needed and the cost of the material. The job of filling the holes in the town of Klamath was given to a local contractor (without bids) at the rate of \$0.95 per cubic yard, for 51,000 cubic yards of fill.

Immediately after the hole-filling project was started, two protests were made: first, that the fill material was too costly; second, that this program would raise the value of some private property above its pre-flood worth. The



**Flood-made hole and projecting sidewalk where house once stood in Klamath.**

health department advised the board of supervisors that the holes had to be filled because of the extreme hazard they presented, whether or not they had been there before the flood. The department's position was supported by the chief of the bureau of sanitary engineering of the State health department and by the director of civil defense of Los Angeles County on loan to Del Norte County. In order to eliminate the hazard as soon as possible, the board of supervisors awarded the contract and disregarded the property improvement argument.

More than 41 parcels of land in the urban sections of the disaster area were filled. In the town of Klamath, 5 major holes covering 19 parcels of property occupied before the flood were filled under the contract. Three other holes in Klamath, 8 parcels of land in Terwer Valley, and 12 parcels of land in the Klamath Glen area were filled using the force-account arrangement.

The silting in of natural drainage courses

by the flood had changed and blocked surface water drainage in the vicinity of the town of Klamath. This condition caused local flooding covering several blocks in the town and affected the rehabilitation of those individual sewage disposal systems which still existed after the flood. Heavy equipment was used to fill minor depressions, level off irregular ground, and open up new drainage channels. The county road department helped with the problem.

Efforts to rehabilitate the area's two community water systems—one in the town of Klamath and the other in Terwer Valley—received support and technical assistance from the State health department. Restoration of the Terwer Valley system was accomplished right after the flood with minor repairs to the distribution lines and decontamination of the well supply. On the other hand, trying to get the Klamath water system rehabilitated was the most frustrating task on the postdisaster program.

Before the flood, equipment, operation, and maintenance by the private water company serving Klamath were below standard for a community water system. The system was severely damaged by the flood, and yet, despite constant urging by State and local agencies, no major repairs were undertaken by the company until after May 1956. That was 5 months after the flood.

But as soon as the cleanup program began in late December 1955, we needed water under pressure for washing down the commercial establishments and houses that were encrusted with flood-deposited silt. After the main lines were patched up, the Klamath water system was able to furnish water for cleanup activities such as "wash down."

The water could not be declared safe for domestic use, however. There were major leaks which could allow surface water to backflow into the system, and there were broken mains.

In circumstances like these, disinfecting the water provides some measure of safety. An emergency hypochlorinator was borrowed from the State office of civil defense, installed in the system, and turned over to the water company for operation. As it turned out, the hypochlorinator was used off and on for a while, and then it lay idle even though both State and local health personnel continued to urge its use.

The sanitation staff could not take over maintenance of the hypochlorinator, for we had neither time of our own to spare nor another qualified man available. From this experience we learned a very important lesson in disaster sanitation: emergency civil defense equipment, no matter how modern nor how needed, is useless if trained personnel are not on hand to use it properly.

In the case of the Klamath water system, the health department was caught in a dilemma. The purity of the water being supplied by the water company was questionable; the department had no legal power to insist that the company use the emergency disinfecting equipment or else undertake rehabilitation immediately; and the water was needed for important cleanup activities.

A backward look at the various postflood water problems shows that the sanitation staff



*Courtesy Harris Studio*

#### **A flood-damaged building is burned in the cleanup program.**

was able to handle emergency needs and problems of simple reconstruction. We failed to bring about the major rehabilitation of a community water system which its private owners, for financial or other reasons, would not undertake on their own. An important cause for this failure was the absence of any legal authority which would have enabled the county or the State to step in.

The rebuilding of sanitary facilities, buildings, and emergency housing was a joint venture of Del Norte County and the State division of housing. The division of housing performed most of the work under the authority of an emergency county building permit ordinance. The health department inspected emergency housing units (trailers) for general sanitation.

#### **Special Problems**

The flood debris removal program presented some special administrative and health problems not anticipated as part of the postdisaster planning. As the disaster relief program progressed, it became apparent that on rigid administrative policies could be set and maintained. Instead a fluid, or command decision,

approach was required of the health department and the county.

One of the main problems was to set up emergency payrolls for the cleanup crews and rental fees for the heavy equipment used. Del Norte County was fortunate in having a county auditor who was able to grasp quickly the financial intricacies of Public Law 875 and to set up the accounting methods and books necessary for the functioning of the program.

The difficulty arose in signing up a fluid working force and hiring heavy transit equipment, both of which were already working in the disaster area, and in organizing an emergency payroll. In the beginning, a bewildered timekeeper listed the name of the worker or the owner of the equipment and the hours spent on cleanup work on slips of paper and hastily bought timebooks. Initially the loose-knit organization and supervision of the crews caused such confusion in timekeeping and the placing of workers that supplemental payrolls were required to set things straight. This situation was remedied when rates of pay and rental fees for equipment were established, crews properly hired and supervised, and social security numbers and withholding tax categories obtained.

A hindsight look at this problem of emergency payrolls for disaster work shows the need for having an emergency payroll and proper administrative procedures set up as part of civil defense planning. We will not soon forget the nightmare, just after the disaster, of organizing a payroll for people dependent upon the paycheck to feed and clothe their families.

A serious health problem arose during the cleanup program concerning the illegal distribution of quarantined foodstuffs. The health department had posted and placed all food establishments and taverns under quarantine immediately after the flood, but adequate manpower was not available for enforcement. Foodstuffs were looted and picked up in the flooded area. Efforts by Federal, State, and local food inspectors to survey for condemnation or release of foodstuffs did little to stop the practice. We faced the same problem at the county dump, which was the designated place for the dumping of flood debris. Although the

dump was posted with warnings against taking condemned foodstuffs, people continued to raid it. In spite of this illegal distribution of foodstuffs, no reported cases of serious food poisoning came to the attention of the health department.

An additional public health hazard came from the contaminated silt which settled throughout the town as an aftermath of the flood. Our first plans were to make silt removal the responsibility of the private property owner. Soon it became apparent that the foul smelling silt, mixed with organic waste material and sewage effluent, was too much for individual owners to cope with; they were only moving the contaminated silt—and the hazard—from one place to another. In order to get it done properly, the county undertook silt removal.

We used heavy equipment to scrape and remove the contaminated silt from private property to the county roads. From there it was picked up by truck and hauled away to be used as fill in the deeper holes being filled as part of the general program. In places where heavy equipment could not be used, the silt was spread out for leaching by the rains or disinfection by sunlight and the use of "hot" lime. These areas were posted with warning signs which read "Warning—Raw Sewage in this Area."

One special assignment to the health department was the disposal of lost property picked up by the cleanup crew. Such property was stored in open depots and the one available warehouse in the Klamath area. The material was then inventoried and the list published in a local paper for a period of 90 days. All the property not claimed at the end of this period was sold for the county under the supervision of the health department. Very little property was claimed, and the expenses of collection, transportation, inventorying, and publishing amounted to about \$400. The amount collected by the county from the sale was about \$70. This was one task we had certainly not anticipated as part of emergency sanitation work.

### **Analysis**

The entire postflood disaster program, which included flood-debris removal, cleaning of septic tanks, filling of holes, and general emergency

sanitation work, covered a period of 16 weeks, December 27, 1955, to April 14, 1956. Most of the flood debris was removed in the first 7 weeks, with an average daily working force of 130 for the first 2 weeks, decreasing to an average daily crew of 24 for the seventh week and the use of 1 or 2 men for the remainder of the period. The hole-filling program was completed in the 16th week after the flood. Because of the extreme urgency for cleaning up the disaster areas and the possibility of losing the labor force with the reopening of local industries, large crews were used except in the Klamath Glen area. In spite of adverse weather, most of the town of Klamath and partial sections of Terwer Valley and Klamath Glen were cleaned up by the seventh week after the flood.

A review of the program shows that the department accomplished the cleanup in what could be considered record time, prevented the possible outbreak of a major epidemic, and improved the environmental sanitation of the disaster area. The county and the health department attempted to return the affected areas

to a state of normalcy, the primary aim of all postdisaster activity. The objectives of the health department were accomplished through the teamwork of Federal, State, and county government officials on the one hand and the citizens on the other.

The long-range rehabilitation problems of proper sewage disposal, adequate and safe water supply, and some measure of flood control face the people of the Klamath area. The health department, in conjunction with other county agencies, has been delegated to help work on these problems. Through continued cooperation and teamwork between county, State, and Federal agencies, in time full rehabilitation can be effected.

#### REFERENCES

- (1) California Department of Public Works: Floods of December 1955 in California. Sacramento, 1956.
- (2) Del Norte County Civil Defense Office: Report on flood of December 21, 1955. Crescent City, Calif., 1956.
- (3) California Department of Public Health: Septic tank systems for private homes. Berkeley, 1953.

## Biology of Water Supplies

Three training courses in water pollution control are scheduled by the Robert A. Taft Sanitary Engineering Center for the fall of 1957. Training in the biology of polluted waters is offered October 7 to 11; the bioassay of toxic wastes, October 14 and 15; and advanced training in detection and control of algae and other interference organisms, November 4 to 8.

Courses are open to personnel in industry, in State, county, and municipal health departments, in water supply and pollution agencies, colleges, universities, and research organizations.

Address requests for further information to the Robert A. Taft Sanitary Engineering Center, Public Health Service, 4676 Columbia Parkway, Cincinnati 26, Ohio.